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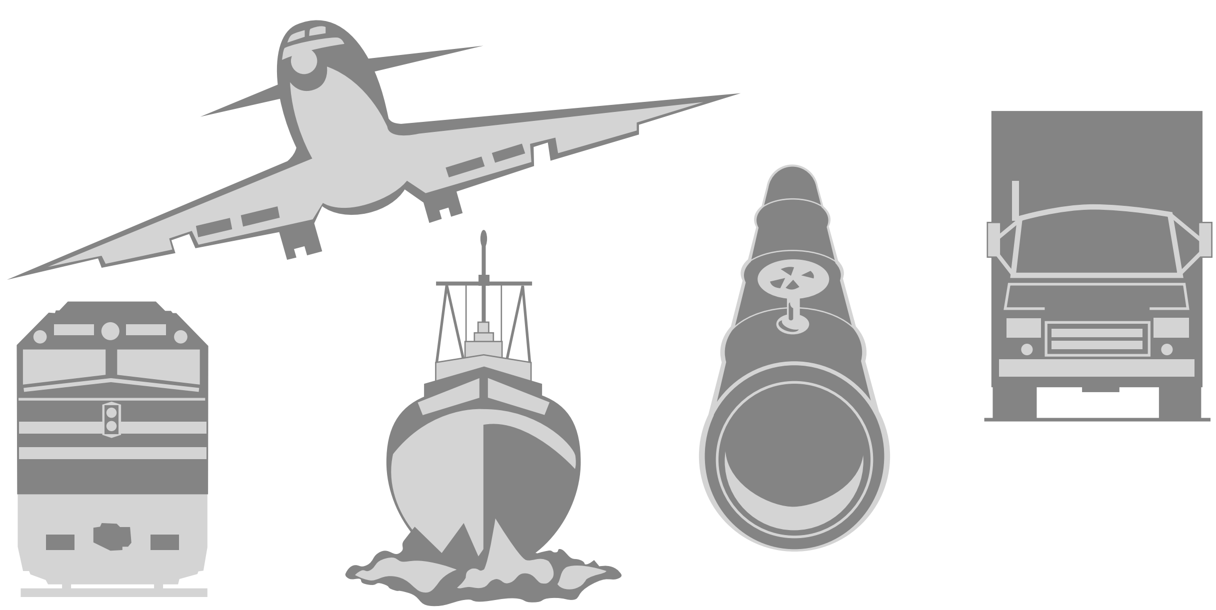
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SAFETY RECOMMENDATIONS

ADOPTED DECEMBER 2002



National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: December 19, 2002

In reply refer to: H-02-33

Ms. Annette M. Sandberg
Acting Administrator
Federal Motor Carrier Safety Administration
400 Seventh Street, S.W.
Washington, DC 20590

About 9:05 p.m. on December 21, 1999, a 1999 Setra 59-passenger motorcoach, operated by Sierra Trailways, Inc. (Sierra Trailways), was traveling eastbound on State Highway 50 along a 7-mile-long downgrade west of Canon City, Colorado, when it began to fishtail while negotiating a curve near milepost (MP) 272.3. At the time, the motorcoach was traveling 63 mph. The speed limit on the descent was 65 mph, with an advisory speed limit of 55 mph on the curves along this section of the roadway. The driver recovered the vehicle from the fishtail, and the motorcoach gained speed as it descended the mountain. Approximately 36 seconds later,[1] as the motorcoach was traveling about 70 mph, the driver lost control of the vehicle on a curve. The motorcoach drifted off the right side of the road, struck MP 273 and a delineator, returned to the road, rotated clockwise 180 degrees toward the centerline, and departed the north side of the roadway backward. The vehicle rolled at least 1.5 times down a 40-foot-deep embankment and came to rest on its roof. The driver and 2 passengers were killed; 33 passengers sustained serious injuries and 24 sustained minor injuries.[2]

The temperature at the time of the accident was in the low 20ºs F with light snow. A Colorado Department of Transportation road crew had been salting and sanding the road throughout the day and reported in a postaccident interview that parts of the roadway were icy. Passengers also described patches of ice and snow on the roadway.

The National Transportation Safety Board determined that the probable cause of this accident was the motorcoach driver's inability to control his vehicle under the icy conditions of the roadway; the driver initiated the accident sequence by inappropriately deciding to use the retarder under icy conditions. Why the busdriver did not, or was unable to, slow the vehicle before the crash could not be determined.

[1] Time sequence derived from the Detroit Diesel Electronic Controls electronic control module (ECM) installed on the engine.

[2] For additional information, read National Transportation Safety Board, Highway Accident Brief, NTSB/HAB-02/19 (Washington, D.C.: NTSB, 2002).

A National Transportation Safety Board simulation of events before the accident, using witness reports, physical evidence, and data downloaded from the Detroit Diesel Electronic Controls IV[3] (DDEC IV) ECM[4] installed on the engine, indicated that the fishtail probably occurred around the curve at MP 272.3. Although the ECM data did not differentiate between application of the brakes and activation of the retarder,[5] investigators were able to determine that the retarder activated before the curve and remained active as the bus entered the curve.[6] The combination of the longitudinal friction for the retarder and the lateral friction required to steer through the curve at 63 mph exceeded the available friction, and the bus fishtail was initiated at the drive axles. The retarder, when applied, requires longitudinal friction at the drive axle wheels. The simulation indicated that if the same longitudinal deceleration that was obtained for the bus using the retarder had been distributed to all six wheels using the bus's antilock brake system (ABS), the bus would have negotiated the curve without losing control because the longitudinal force would have been lower at each wheel.

A retarder/steering-induced wheel slip at the drive axle would have triggered an ABS event,[7] resulting in the retarder being automatically deactivated and the transmission lockup clutch being disengaged, which would have allowed the motorcoach to roll forward with little resistance. A few seconds after the fishtail, the DDEC IV data indicated that the busdriver shifted the transmission into neutral, which took the reverse torque off the drive axle and prevented the retarder from reactivating.[8] Witnesses reported that the busdriver seemed to regain control of the motorcoach at that time.

Data from the DDEC IV indicated that the motorcoach continued to slowly gain speed as it descended the mountain and that the busdriver stepped on the brakes six times before the crash. Five brake applications were held for about 1 second[9] and did not result in a reduction in speed.[10] One brake application lasted about 3 seconds and resulted in a 1.5-mph decrease in speed.

[3] Detroit Diesel's fourth generation control module.

[4] The DDEC IV ECM provides operational data for a vehicle and its engine that are used primarily for diagnostic purposes. Maintenance and fleet managers can draw on the data to review and assess driving performance and its impact on the wear of the vehicle and its engine. The recorded data include trip activity, speed versus rpm, engine load versus rpm, periodic maintenance, engine usage, and hard brake activity.

[5] When active, a vehicle retarder provides a supplemental means of slowing a vehicle, thereby reducing brake wear. A retarder brakes only the drive axle and is activated when a driver releases the throttle. The transmission retarder on the accident motorcoach functioned by creating resistance to slow the transmission output shaft, which is connected to the main drive shaft that ultimately turns the wheels.

[6] Investigators primarily used the DDEC IV "hard brake" report to reconstruct the preaccident and accident events. A "hard brake" report includes data from the previous 1 minute prior to the braking event and 15 seconds after its occurrence. The "hard brake" data relate to vehicle speed at the drive axle, engine rpm, percent throttle, percent engine load, brake use, and clutch use. Brake application is not necessary to trigger a "hard brake" report if the drive axle wheels decelerate at a rate of 7 mph per second or more.

[7] An ABS event occurs when wheel slip is detected by the ABS. Such an event can occur when a driver is braking with the service brakes (brake pedal) on a slippery surface, when retarder/steering-induced wheel slip is detected, or when a vehicle is sliding and wheel slip is detected by the ABS.

[8] The Allison operator's manual states, "If you let the vehicle coast in N (Neutral), there is no engine braking and you could lose control." Had the driver instead placed the retarder lever in the "off" position, the reverse torque would have been taken off the drive axle and the driver would have been able to downshift and use engine resistance to help slow the motorcoach.

[9] According to Detroit Diesel engineers, a single application, representing 1 second on the DDEC "hard brake" report, can be from 1/40 second to 1 39/40 seconds long. The DDEC records brake applications that result in a minimum of 3.5 pounds per square inch of pressure or more.

[10] During four of the five brake applications, the speed of the bus increased 0.5 to 1.0 mph.

As the motorcoach approached MP 273, the busdriver made a throttle application of 2,200 rpm for about 6 seconds on a left-hand curve. About the same time, the bus yawed to the right, departed the roadway shoulder, and went onto the dirt. Physical evidence indicated that the bus struck MP 273 and a delineator before the busdriver was able to steer the motorcoach back onto the pavement. The simulation suggested that the busdriver's steering input was such that it probably angled the bus toward the north embankment on the opposite side of the roadway. The busdriver subsequently steered to the right, initiating a 180-degree-clockwise rotation of the motocoach, and the vehicle traveled backward down the opposite lane. Evidence indicated that the motorcoach's left-rear bumper struck another delineator on the left side of the road, and the bus proceeded backward down the north embankment, rolling at least 1.5 times on its side before coming to rest on its roof.

The accident motorcoach was not the vehicle usually assigned to the busdriver. In October 1998, the driver began operating a 56-seat 1999 Setra and logged about 62,600 miles on that vehicle. Both the 1999 Setra motorcoach and the accident vehicle were equipped with an integral hydraulic retarder mounted at the rear of the transmission. The busdriver received little training on the use of the transmission retarder from either Setra or Sierra Trailways.[11]

Prior to driving the 56-seat 1999 Setra, the busdriver operated a 1998 Prevost model H3-45 for about a year. This Prevost motorcoach was equipped with an engine retarder, which is generally less powerful than a transmission retarder.[12] Before operating the 1998 Prevost motorcoach, the busdriver drove other Prevost models that were also equipped with engine retarders.

According to the president of Sierra Trailways, the busdriver had made about 50 trips to Colorado ski resorts, including 7 to Crested Butte. However, he believed that the accident trip was the first time that the busdriver had operated a transmission retarder-equipped motorcoach into the mountains during winter.[13] Therefore, the busdriver had driven an engine retarder-equipped motorcoach on virtually all his trips to the Colorado mountains. Because of his extensive experience with engine retarders and lack of training and experience with transmission retarders, he may not have been fully aware of the differences between the two types of retarders, which may have influenced his selection of a retarder setting and ultimately led to the fishtail.

After the accident, the motorcoach's seven-position retarder lever was found in the second highest retarder position. Safety Board investigators found that the retarder lever could be moved easily from setting to setting. Since the lever may have been dislodged during the accident sequence, the true position of the retarder lever could not be determined reliably from the physical evidence. DDEC IV data and the Safety Board's accident simulation indicated that the retarder was on a high setting[14] at the time of the fishtail. Both the Setra operator's manual and Allison Transmissions (Allison) operator's manual that accompanied the bus warned that the retarder should be turned off when driving the motorcoach on a slippery surface. The Allison

[11] A videotape that accompanied each Setra bus introduced drivers to the retarder control lever. The tape did not describe the retarder functional characteristics or include information on retarder use under various road conditions. Sierra Trailways used this videotape to acquaint drivers with the new Setra buses.

[12] Richard Radlinski, instructor. "Braking Performance of Heavy Commercial Vehicles," Society of Automotive Engineering Seminar, September 10 and 11, 2001, Troy, Michigan.

[13] The Sierra Trailways president stated that he believed that the busdriver had driven to the Colorado mountains during the summer of 1999 in a Setra motorcoach equipped with a transmission retarder.

[14] The transmission retarder lever had six power levels and an "off" position. The lever was probably set on one of the three higher power levels.

manual states, "Using the retarder on wet or slippery roads can be like jamming on the brakes – your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder enable to OFF when driving on wet or slippery roads." The retarder setting selected by the busdriver suggests that he may not have read, or chose to ignore, the warnings in the manuals.

After the retarder/steering-induced fishtail and braking event, the driver apparently shifted the transmission into neutral because he realized that an active retarder might initiate another fishtail. His action suggests that he was not immediately aware of how to turn off the retarder and may have reverted to the technique used by standard transmission drivers to disable the retarder. Using the retarder lever to turn off the retarder, instead of placing the transmission in neutral, would have allowed the driver to downshift and use engine resistance and conventional braking to slow the motorcoach. The Safety Board therefore concludes that the busdriver was not fully aware of how to properly use the transmission retarder.

The Safety Board has investigated a number of truck accidents that have involved the use of retarders during slippery road conditions. The most notable of these occurred in 1985 in Decatur, Texas, when a two-axle truck tractor, pulling two empty 27-foot van trailers, lost control on a slippery 3-percent downgrade and departed the roadway.[15] Investigators determined that the loss of control was initiated by the tractor's engine retarder, which was set at its maximum level. The Safety Board issued recommendations to the National Highway Traffic Safety Administration (NHTSA), the International Brotherhood of Teamsters (IBT), the American Trucking Associations, Inc. (ATA), and engine retarder manufacturers.[16] In response to these recommendations, NHTSA distributed copies of the booklet *A Professional Truck Driver's Guide on the Use of Retarders* to motor carriers and other interested parties; the engine retarder manufacturers revised their manuals to include specific instructions on the use of their retarders on slick surfaces and installed new instructional dashboard placards on all new vehicles; the IBT addressed retarder use in its commercial driver's license training for members and by urging its members to comply with advisory placards provided by the engine manufacturers; and the ATA informed its members of the retarder issues from the Decatur accident in its *Transport Topics* and *Trucking Safely* magazines. The Safety Board has not issued similar recommendations on retarder safety to motorcoach-related industries and associations. The circumstances of the Canon City accident suggest that motorcoach drivers may also benefit from further instruction on the different types of retarders and on their proper use during slippery road conditions.

The National Transportation Safety Board recommends that the Federal Motor Carrier Safety Administration:

> Develop, in cooperation with the United Motorcoach Association and the American Bus Association, a booklet that educates motorcoach drivers on the different types of retarders and on their use during low-friction-coefficient road conditions. Then, distribute this information to motorcoach carriers and other interested parties. (H-02-33)

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[15] NTSB-FTW-85-H-TR38.

[16] Safety Recommendations H-89-38 and -40 through -44. Safety Recommendation H-89-38 has been classified "Closed – Acceptable Alternate Action." The other recommendations have been classified "Closed – Acceptable Action."

The Safety Board also issued safety recommendations to the United Motorcoach Association, the American Bus Association, the Institute of Electrical and Electronics Engineers, and the Society of Automotive Engineers. In your response to the recommendation in this letter, please refer to Safety Recommendation H-02-33. If you need additional information, you may call (202) 314-6177.

Acting Chairman **CARMODY**, and Members **HAMMERSCHMIDT**, **GOGLIA**, and **BLACK** concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board
Washington, DC 20594

Safety Recommendation

Date: December 19, 2002

In reply to refer to: H-02-34

Mr. Victor S. Parra
Chief Executive Officer
United Motorcoach Association
113 South West Street
Alexandria, Virginia 22314

Mr. Peter Pantuso
President and Chief Executive Officer
American Bus Association
1100 New York Avenue, N.W.
Washington, DC 20005

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the need to educate busdrivers on the different types of retarders and their proper use during slippery road conditions. This recommendation is derived from the Safety Board's investigation of the December 21, 1999, motorcoach run-off-the-road accident near Canon City, Colorado,[1] and is consistent with the evidence found and the analysis performed. As a result of this investigation, the Safety Board has issued three safety recommendations, one of which is addressed to the United Motorcoach Association and the American Bus Association. Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 9:05 p.m. on December 21, 1999, a 1999 Setra 59-passenger motorcoach, operated by Sierra Trailways, Inc. (Sierra Trailways), was traveling eastbound on State Highway 50 along a 7-mile-long downgrade west of Canon City, Colorado, when it began to fishtail while negotiating a curve near milepost (MP) 272.3. At the time, the motorcoach was traveling 63 mph. The speed limit on the descent was 65 mph, with an advisory speed limit of 55 mph on the curves along this section of the roadway. The driver recovered the vehicle from the fishtail, and the motorcoach gained speed as it descended the mountain. Approximately 36 seconds later,[2] as

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[2] Time sequence derived from the Detroit Diesel Electronic Controls electronic control module (ECM) installed on the engine.

the motorcoach was traveling about 70 mph, the driver lost control of the vehicle on a curve. The motorcoach drifted off the right side of the road, struck MP 273 and a delineator, returned to the road, rotated clockwise 180 degrees toward the centerline, and departed the north side of the roadway backward. The vehicle rolled at least 1.5 times down a 40-foot-deep embankment and came to rest on its roof. The driver and 2 passengers were killed; 33 passengers sustained serious injuries and 24 sustained minor injuries.

The temperature at the time of the accident was in the low 20ºs F with light snow. A Colorado Department of Transportation road crew had been salting and sanding the road throughout the day and reported in a postaccident interview that parts of the roadway were icy. Passengers also described patches of ice and snow on the roadway.

The National Transportation Safety Board determined that the probable cause of this accident was the motorcoach driver's inability to control his vehicle under the icy conditions of the roadway; the driver initiated the accident sequence by inappropriately deciding to use the retarder under icy conditions. Why the busdriver did not, or was unable to, slow the vehicle before the crash could not be determined.

A National Transportation Safety Board simulation of events before the accident, using witness reports, physical evidence, and data downloaded from the Detroit Diesel Electronic Controls IV[3] (DDEC IV) ECM[4] installed on the engine, indicated that the fishtail probably occurred around the curve at MP 272.3. Although the ECM data did not differentiate between application of the brakes and activation of the retarder,[5] investigators were able to determine that the retarder activated before the curve and remained active as the bus entered the curve.[6] The combination of the longitudinal friction for the retarder and the lateral friction required to steer through the curve at 63 mph exceeded the available friction, and the bus fishtail was initiated at the drive axles. The retarder, when applied, requires longitudinal friction at the drive axle wheels. The simulation indicated that if the same longitudinal deceleration that was obtained for the bus using the retarder had been distributed to all six wheels using the bus's antilock brake system (ABS), the bus would have negotiated the curve without losing control because the longitudinal force would have been lower at each wheel.

A retarder/steering-induced wheel slip at the drive axle would have triggered an ABS event,[7] resulting in the retarder being automatically deactivated and the transmission lockup clutch being disengaged, which would have allowed the motorcoach to roll forward with little

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resistance. A few seconds after the fishtail, the DDEC IV data indicated that the busdriver shifted the transmission into neutral, which took the reverse torque off the drive axle and prevented the retarder from reactivating.[8] Witnesses reported that the busdriver seemed to regain control of the motorcoach at that time.

Data from the DDEC IV indicated that the motorcoach continued to slowly gain speed as it descended the mountain and that the busdriver stepped on the brakes six times before the crash. Five brake applications were held for about 1 second[9] and did not result in a reduction in speed.[10] One brake application lasted about 3 seconds and resulted in a 1.5-mph decrease in speed.

As the motorcoach approached MP 273, the busdriver made a throttle application of 2,200 rpm for about 6 seconds on a left-hand curve. About the same time, the bus yawed to the right, departed the roadway shoulder, and went onto the dirt. Physical evidence indicated that the bus struck MP 273 and a delineator before the busdriver was able to steer the motorcoach back onto the pavement. The simulation suggested that the busdriver's steering input was such that it probably angled the bus toward the north embankment on the opposite side of the roadway. The busdriver subsequently steered to the right, initiating a 180-degree-clockwise rotation of the motocoach, and the vehicle traveled backward down the opposite lane. Evidence indicated that the motorcoach's left-rear bumper struck another delineator on the left side of the road, and the bus proceeded backward down the north embankment, rolling at least 1.5 times on its side before coming to rest on its roof.

The accident motorcoach was not the vehicle usually assigned to the busdriver. In October 1998, the driver began operating a 56-seat 1999 Setra and logged about 62,600 miles on that vehicle. Both the 1999 Setra motorcoach and the accident vehicle were equipped with an integral hydraulic retarder mounted at the rear of the transmission. The busdriver received little training on the use of the transmission retarder from either Setra or Sierra Trailways.[11]

Prior to driving the 56-seat 1999 Setra, the busdriver operated a 1998 Prevost model H3-45 for about a year. This Prevost motorcoach was equipped with an engine retarder, which is generally less powerful than a transmission retarder.[12] Before operating the 1998 Prevost motorcoach, the busdriver drove other Prevost models that were also equipped with engine retarders.

According to the president of Sierra Trailways, the busdriver had made about 50 trips to Colorado ski resorts, including 7 to Crested Butte. However, he believed that the accident trip was the first time that the busdriver had operated a transmission retarder-equipped motorcoach

[8] The Allison operator's manual states, "If you let the vehicle coast in N (Neutral), there is no engine braking and you could lose control." Had the driver instead placed the retarder lever in the "off" position, the reverse torque would have been taken off the drive axle and the driver would have been able to downshift and use engine resistance to help slow the motorcoach.

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into the mountains during winter.[13] Therefore, the busdriver had driven an engine retarder-equipped motorcoach on virtually all his trips to the Colorado mountains. Because of his extensive experience with engine retarders and lack of training and experience with transmission retarders, he may not have been fully aware of the differences between the two types of retarders, which may have influenced his selection of a retarder setting and ultimately led to the fishtail.

After the accident, the motorcoach's seven-position retarder lever was found in the second highest retarder position. Safety Board investigators found that the retarder lever could be moved easily from setting to setting. Since the lever might have been dislodged during the accident sequence, the true position of the retarder lever could not be determined reliably from the physical evidence. DDEC IV data and the Safety Board's accident simulation indicated that the retarder was on a high setting[14] at the time of the fishtail. Both the Setra operator's manual and Allison Transmissions (Allison) operator's manual that accompanied the bus warned that the retarder should be turned off when driving the motorcoach on a slippery surface. The Allison manual states, "Using the retarder on wet or slippery roads can be like jamming on the brakes – your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder enable to OFF when driving on wet or slippery roads." The retarder setting selected by the busdriver suggests that he may not have read, or chose to ignore, the warnings in the manuals.

After the retarder/steering-induced fishtail and braking event, the driver apparently shifted the transmission into neutral because he realized that an active retarder might initiate another fishtail. His action suggests that he was not immediately aware of how to turn off the retarder and may have reverted to the technique used by standard transmission drivers to disable the retarder. Using the retarder lever to turn off the retarder, instead of placing the transmission in neutral, would have allowed the driver to downshift and use engine resistance and conventional braking to slow the motorcoach. The Safety Board therefore concludes that the busdriver was not fully aware of how to properly use the transmission retarder.

The Safety Board has investigated a number of truck accidents that have involved the use of retarders during slippery road conditions. The most notable of these occurred in 1985 in Decatur, Texas, when a two-axle truck tractor, pulling two empty 27-foot van trailers, lost control on a slippery 3-percent downgrade and departed the roadway.[15] Investigators determined that the lost of control was initiated by the tractor's engine retarder, which was set at its maximum level. The Safety Board issued recommendations to the National Highway Traffic Safety Administration (NHTSA), the International Brotherhood of Teamsters (IBT), the American Trucking Associations, Inc. (ATA), and engine retarder manufacturers.[16] In response to these recommendations, NHTSA distributed copies of the booklet *A Professional Truck Driver's Guide on the Use of Retarders* to motor carriers and other interested parties; the engine retarder manufacturers revised their manuals to include specific instructions on the use of their retarders on slick surfaces and installed new instructional dashboard placards on all new vehicles; the IBT addressed retarder use in its commercial driver's license training for members

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[15] NTSB-FTW-85-H-TR38.

[16] Safety Recommendations H-89-38 and -40 through -44. Safety Recommendation H-89-38 has been classified "Closed – Acceptable Alternate Action." The other recommendations have been classified "Closed – Acceptable Action."

and by urging its members to comply with advisory placards provided by the engine manufacturers; and the ATA informed its members of the retarder issues from the Decatur accident in its *Transport Topics* and *Trucking Safely* magazines. The Safety Board has not issued similar recommendations on retarder safety to motorcoach-related industries and associations. The circumstances of the Canon City accident suggest that motorcoach drivers may also benefit from further instruction on the different types of retarders and on their proper use during slippery road conditions.

The National Transportation Safety Board recommends that the American Bus Association and the United Motorcoach Association:

> Work with the Federal Motor Carrier Safety Administration to develop a booklet that educates motorcoach drivers on the different types of retarders and on their use during low-friction-coefficient road conditions. Then, distribute this information to motorcoach carriers and other interested parties. (H-02-34)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, the Institute of Electrical and Electronics Engineers, and the Society of Automotive Engineers. In your response to the recommendation in this letter, please refer to Safety Recommendation H-02-34. If you need additional information, you may call (202) 314-6177.

Acting Chairman **CARMODY**, and Members **HAMMERSCHMIDT**, **GOGLIA**, and **BLACK** concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board
Washington, DC 20594

Safety Recommendation

Date: December 19, 2002

In reply to refer to: H-02-35

Mr. Daniel Senese
Executive Director
Institute of Electrical and Electronics Engineers
445 Hoes Lane
Piscataway, New Jersey 08854-1331

Dr. S. M. Shahed
President
Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, Pennsylvania 15096

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the lack of standards for recording time and status information for the faults stored in electronic control units (ECUs). The recommendation is derived from the Safety Board's investigation of the December 21, 1999, motorcoach run-off-the-road accident near Canon City, Colorado,[1] and is consistent with the evidence found and the analysis performed. As a result of this investigation, the Safety Board has issued three safety recommendations, one of which is addressed to the Institute of Electrical and Electronics Engineers and the Society of Automotive Engineers. Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

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A retarder/steering-induced wheel slip at the drive axle would have triggered an ABS event,[7] resulting in the retarder being automatically deactivated and the transmission lockup clutch being disengaged, which would have allowed the motorcoach to roll forward with little

[3] Detroit Diesel's fourth generation control module.

[4] The DDEC IV ECM provides operational data for a vehicle and its engine that are used primarily for diagnostic purposes. Maintenance and fleet managers can draw on the data to review and assess driving performance and its impact on the wear of the vehicle and its engine. The recorded data include trip activity, speed versus rpm, engine load versus rpm, periodic maintenance, engine usage, and hard brake activity.

[5] When active, a vehicle retarder provides a supplemental means of slowing a vehicle, thereby reducing brake wear. A retarder brakes only the drive axle and is activated when a driver releases the throttle. The transmission retarder on the accident motorcoach functioned by creating resistance to slow the transmission output shaft, which is connected to the main drive shaft that ultimately turns the wheels.

[6] Investigators primarily used the DDEC IV "hard brake" report to reconstruct the preaccident and accident events. A "hard brake" report includes data from the previous 1 minute prior to the braking event and 15 seconds after its occurrence. The "hard brake" data relate to vehicle speed at the drive axle, engine rpm, percent throttle, percent engine load, brake use, and clutch use. Brake application is not necessary to trigger a "hard brake" report if the drive axle wheels decelerate at a rate of 7 mph per second or more.

[7] An ABS event occurs when wheel slip is detected by the ABS. Such an event can occur when a driver is braking with the service brakes (brake pedal) on a slippery surface, when retarder-induced wheel slip is detected, or when a vehicle is sliding and wheel slip is detected by the ABS.

resistance. A few seconds after the fishtail, the DDEC IV data indicated that the busdriver shifted the transmission into neutral, which took the reverse torque off the drive axle and prevented the retarder from reactivating.[8] Witnesses reported that the busdriver seemed to regain control of the motorcoach at that time.

Data from the DDEC IV indicated that the motorcoach continued to slowly gain speed as it descended the mountain and that the busdriver stepped on the brakes six times before the crash. Five brake applications were held for about 1 second[9] and did not result in a reduction in speed.[10] One brake application lasted about 3 seconds and resulted in a 1.5-mph decrease in speed.

As the motorcoach approached MP 273, the busdriver made a throttle application of 2,200 rpm for about 6 seconds on a left-hand curve. About the same time, the bus yawed to the right, departed the roadway shoulder, and went onto the dirt. Physical evidence indicated that the bus struck MP 273 and a delineator before the busdriver was able to steer the motorcoach back onto the pavement. The simulation suggested that the busdriver's steering input was such that it probably angled the bus toward the north embankment on the opposite side of the roadway. The busdriver subsequently steered to the right, initiating a 180-degree-clockwise rotation of the motorcoach, and the vehicle traveled backward down the opposite lane. Evidence indicated that the motorcoach's left-rear bumper struck another delineator on the left side of the road, and the bus proceeded backward down the north embankment, rolling at least 1.5 times on its side before coming to rest on its roof.

Despite the fishtail about a mile before the accident site, the driver did not, or was unable to, reduce the speed of the motorcoach as it continued downhill. On December 22 and 23, 1999, Safety Board and Colorado State Patrol investigators conducted a preliminary brake inspection on the accident bus and found a small leak in a fitting for the service intake to the right-drive-axle air chamber. On February 3 and 4, 2000, the Safety Board and the Colorado State Patrol, together with Bendix Commercial Vehicle Systems and Setra personnel, conducted a full inspection of the braking system. When the brake system's damaged parts (the air chamber, push rod, and slack adjuster on the left drive axle and the service hose and fitting on the right drive axle) were replaced and the auxiliary air system isolated, investigators found no leaks or irregularities in the system.

During the full inspection, investigators downloaded the contents of the ABS's ECU. The contents included two fault codes, which is the maximum number of faults that this ECU can store. The faults pertained to errors in the right-front and right-rear modulator valves.[11] An engineer from the Robert Bosch Corporation believed that the modulator valve fault codes were due to low voltage from a drained battery. Checking the voltage with a voltmeter, the engineer found it to be 12.42 volts. (The Bosch ABS's ECU operates on a 24-volt system.) When the

[8] The Allison operator's manual states, "If you let the vehicle coast in N (Neutral), there is no engine braking and you could lose control." Had the driver instead placed the retarder lever in the "off" position, the reverse torque would have been taken off the drive axle and the driver would have been able to downshift and use engine resistance to help slow the motorcoach.

[9] According to Detroit Diesel engineers, a single application, representing 1 second on the DDEC "hard brake" report, can be from 1/40 second to 1 39/40 seconds long. The DDEC records brake applications that result in a minimum of 3.5 pounds per square inch of pressure or more.

[10] During four of the five brake applications, the speed of the bus increased 0.5 to 1.0 mph.

[11] A modulator valve is an electro-pneumatic control valve that contains the solenoids used to precisely modulate brake air pressure during an antilock braking system event.

motorcoach batteries were charged to 24 volts, the codes did not reappear. Further examination of the ABS using a standard checklist uncovered no problems.

On August 16, 2000, Safety Board investigators and a Setra field representative drained the motorcoach battery in an attempt to reproduce the modulator valve fault codes found during the February 3, 2000, inspection of the ABS. The battery was drained from 24 volts to 11.2 volts,[12] and no fault codes registered. Again on February 16, 2001, when Setra and Bosch engineers and Safety Board investigators tried to recreate the fault codes by draining the battery, the codes did not reappear. After charging the battery to 24 volts, it was drained twice to about 11 volts. The modulator valve fault codes could not be reproduced. However, an undervoltage code did appear at 12 volts and at 11.8 volts.

Fault codes such as those detected by the ABS's ECU can either limit the ABS function or revert the braking completely to conventional air brake control. The Setra operating manual states, "In the event of the fault occurring, the driver can usually still call upon the conventional service brakes."

Because the ABS ECU was designed to store no more than two fault codes, additional fault codes may have been present but ignored or overwritten by the ECU. The two fault codes present were not dated or time stamped, nor were they labeled as "active" or "inactive."

In addition to that data stored in the ABS ECU, data were also downloaded from the transmission ECU. Five fault codes were discovered. Two of the fault codes had been registered after the accident.[13] Two other fault codes occurred before the accident trip and would not have interfered with the driver's control of the bus.[14] The fifth (code 22-16), an "output shaft speed sensor" fault, indicated that before or during the accident, the transmission experienced either an interruption in its electrical contact with the shaft speed sensor or the transmission ECU sensed a speed change so rapid that it determined this change to be "unreasonable."

Under normal operation, the output shaft speed sensor only allows the driver to shift into neutral or into a gear appropriate to the current speed of the bus. When code 22-16 is registered, the driver is prevented from shifting into any gear, the transmission retarder is disabled, and the lockup clutch is disengaged. Attempting to correct the fault would require a driver to stop the motorcoach, turn off the ignition for about 10 seconds, and then restart the ignition. During interviews, no passengers mentioned the bus stopping. When discovered, the output shaft speed sensor fault (code 22-16) was inactive, indicating that the condition that triggered it was no longer present. The transmission ECU fault codes were not date and time stamped, so investigators were unable to determine when the fault occurred or whether the fault had any effect on the operation of the bus before the accident.

[12] Between 11 and 12 volts is needed to power the ignition; no testing could be done when the voltage dropped below that level.

[13] The ECU registered nine ignition cycles, which were probably recorded during the initial Safety Board and Colorado State Patrol vehicle inspections that occurred during the 2 days after the accident. When these data were downloaded, the information on two fault codes indicated that the engine had not been cycled since their registration, a sign that they occurred during download.

[14] An engine speed sensor code (22-14) occurred two ignition cycles before the accident trip. This fault would not have affected the transmission's ability to shift gears but can result in harsh shifts. A throttle message fault (66-00) occurred 12 ignition cycles before the accident trip. This fault also would not have affected the transmission's ability to shift gears.

On August 16, 2000, Safety Board investigators and Allison Transmissions technicians conducted electrical continuity testing between the shift control and the speed sensor. The test indicated no defects. On the following day, the output shaft speed sensor was placed into a sister vehicle (another 1999 Setra) and performed normally.

The fault codes stored in both the ABS ECU and the transmission ECU were not time stamped, and the ABS ECU faults lacked status indication. These factors limited the usefulness of both ECUs as diagnostic or investigative tools and made it difficult for investigators to determine whether the faults were factors in this accident. Furthermore, the limited capacity available for storing ABS ECU data means that additional fault codes may have been present but were overwritten. The Safety Board concludes that had the faults on the transmission and ABS ECUs been time stamped, had the status of the faults on the ABS ECU been known, and had the ABS ECU been able to store a greater number of codes, a more comprehensive account of the events leading up to the motorcoach crash would have been possible.

The National Transportation Safety Board recommends that the Institute of Electrical and Electronics Engineers and the Society of Automotive Engineers:

> Work together, as part of your initiative to establish on-board vehicle recorder standards, to develop standards for brake and transmission electronic control units that require those units to store a full history of electronic fault codes that are time stamped using a recognized clock synchronized with other on-board event data recording devices. (H-02-35)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, the United Motorcoach Association, and the American Bus Association. In your response to the recommendation in this letter, please refer to Safety Recommendation H-02-35. If you need additional information, you may call (202) 314-6177.

Acting Chairman **CARMODY**, and Members **HAMMERSCHMIDT**, **GOGLIA**, and **BLACK** concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December, 30 2002

In reply refer to: M-02-25 through -28

Admiral Thomas H. Collins
Commandant
U.S. Coast Guard
Washington, D.C. 20593-0001

On the evening of January 12, 2002, the 24-foot U.S. Coast Guard patrol boat *CG242513*, with two crewmembers on board, was on a routine recreational boating safety and manatee-zone patrol in Biscayne Bay, Florida, when it collided with the small passenger vessel *Bayside Blaster*, carrying 2 crewmembers and 53 passengers. Both Coast Guard crewmembers were ejected from their boat. The patrol boat continued running and struck the *Bayside Blaster* again, struck a moored recreational boat twice, and finally came to rest against pilings at nearby Palm Island. Police officers responding to the scene pinned the patrol boat to the pilings and shut off the engines. Five passengers who reported being injured were taken to Coast Guard Station Miami Beach. After triage, two passengers were transported to a hospital; the others did not request further medical treatment. The two Coast Guard crewmembers were triaged by paramedics on Palm Island, taken to a nearby hospital for further examination, and released the morning of January 13. No deaths resulted from the accident. Total damages were estimated at $184,722.[1]

The National Transportation Safety Board (Safety Board) determined that the probable cause of the collision between the Coast Guard patrol boat and the *Bayside Blaster* was the failure of the coxswain of the patrol boat to operate his vessel at a safe speed in a restricted-speed area frequented by small passenger vessels and in conditions of limited visibility due to darkness and background lighting. Contributing to the cause of the accident was the lack of adequate Coast Guard oversight of nonstandard boat operations. Based on its investigation, the Safety Board identified four safety issues related to Coast Guard operations: (1) operation of the Coast Guard patrol boat, (2) Coast Guard oversight of routine patrols, (3) kill switch operation on Coast Guard nonstandard boats, and (4) Coast Guard safety oversight of small passenger vessels in Miami.

[1] For further information, read National Transportation Safety Board, *Collision Between the U.S. Coast Guard Patrol Boat* CG242513 *and the U.S. Small Passenger Vessel* Bayside Blaster*, Biscayne Bay, Florida, January 12, 2002*, Marine Accident Report NTSB/MAR-02/05 (Washington, DC: NTSB, 2002).

At the time of the accident, the Coast Guard lacked guidelines on speed for routine patrols, which in the Safety Board's view allowed coxswains too much latitude in selecting patrol speeds. Most of Biscayne Bay has speed restrictions imposed by Florida to protect manatees, an endangered marine mammal. The Coast Guard boat was conducting a routine patrol, rather than an emergency operation, on the night of the accident, and so was not exempt from the manatee-zone speed restrictions. The coxswain testified to Safety Board investigators that he knew he was approaching a manatee-protection zone as his patrol boat rounded Hibiscus Island (about 400 yards from the accident location). He also testified that he knew there was a blind spot coming around the end of the island. Yet he entered the zone at full speed (32 knots). Even in daylight, the speed at which the coxswain was operating would have been illegal and inappropriate in the area. And even if there were no speed restrictions, the coxswain's speed was imprudent for the prevailing conditions of darkness, background lighting from various sources such as bridges and office buildings, and potential for encountering passenger and recreational vessels in the area of the accident.

Further, Safety Board investigators found that the coxswain had undertaken the patrol without completing a thorough predeparture check of the patrol boat and without ensuring that his port navigation light, a critical piece of equipment, was fully functional. According to the coxswain, when he got under way, the crew of another Coast Guard boat informed him that his port navigation light was not operating. The coxswain tapped the fixture and the light came on. In the Safety Board's opinion, the coxswain should have realized that the light might have been subject to intermittent operation and should have not taken the vessel on a nighttime patrol without ensuring that the light was showing steadily. In addition, the coxswain provided no details of his intended route (float plan) before departing, and the duty officer did not request one. Further, there was no discussion of speed issues or of the condition of the boat that was to be used for the patrol before the boat got under way. Those omissions indicated to the Safety Board that there was a lack of effective oversight of patrol operations at Coast Guard Station Miami Beach.

After the *Bayside Blaster* accident and as a result of an internal Coast Guard investigation of a fatal small boat accident in March 2001, the Coast Guard Commandant instructed the Assistant Commandant for Operations to ensure that small boat coxswains file a float plan before departing on patrol and that they notify their controlling station if they deviate from the plan. The float plan requirements, in the Safety Board's opinion, will provide a measure of oversight over Coast Guard small boat operations. But by themselves, they still fall short of the degree of oversight necessary to ensure operational safety. Oversight could be improved by various means, such as direct observation of coxswains' performance by station officials and solicitation of feedback from waterway users, as well as greater formality in the conduct of routine patrols. For example, if coxswains were required to complete a written checklist before getting under way, they might be more likely to conduct thorough predeparture checks. If detailed predeparture briefings were held, coxswains might be more mindful of operational restraints. And if detailed postpatrol debriefings were held, coxswains might be less likely to take actions they could be held accountable for.

Other changes made by the Coast Guard since the *Bayside Blaster* accident, such as issuing a *Non-standard Boat Operators Handbook* that cautions against operating vessels at excessive speed and requiring in the new *Navigation Standards Manual* that commanding officers impose specific operating restrictions (such as speed limits), should help improve the safety of nonstandard boat operations. Ongoing evaluation and the establishment of verification procedures are, however, essential to ensure compliance with the Coast Guard's policies and procedures regarding the operation of nonstandard boats.

One question in the Safety Board's investigation of the *Bayside Blaster* accident was why the Coast Guard patrol boat's engines continued to run after the coxswain was thrown overboard. The patrol boat was equipped with an engine kill switch mounted on the console. A plastic loop on one end of a coiled lanyard fit over the kill switch, and the other end of the lanyard was connected to a plastic clip on the coxswain's belt. The system was designed so that if the loop-and-lanyard assembly were pulled in any direction from the kill switch, the engines would stop. When the patrol boat lodged against the pilings at Palm Island, however, its engines were still running. If the kill switch lanyard and clip had operated properly, the engines would have shut down as soon as the coxswain was ejected from the patrol boat. If the engines had stopped, the patrol boat would not have struck the *Bayside Blaster* the second time, the other damages would not have occurred, and the Coast Guard crewmembers would not have been placed in jeopardy of being run over by their own vessel.

The Safety Board's Materials Laboratory examined the kill switch lanyard and the coxswain's belt clip, which was broken. The examination indicated that the belt clip was the weak link in the lanyard assembly, suggesting that either the belt clip was the wrong attachment or that the lanyard may have wrapped itself around another item on the console, such as the steering wheel, thereby transferring all the force to the belt instead of to the kill switch. The two Coast Guard crewmembers confirmed that the kill switch lanyard was connected both to the kill switch and to the coxswain, and the police saw the kill switch lanyard connected to the kill switch when the patrol boat came to rest against the pilings on Palm Island. The Safety Board concluded that it could not be determined why the kill switch did not activate when the coxswain was ejected or whether fouling of the kill switch lanyard on the steering wheel was a factor in the engines' failure to stop.

On January 30, 2002, two weeks after the accident, the Coast Guard sent a safety advisory to all Coast Guard units that appears to address most of the problems with kill switch malfunction. For example, the advisory requires that kill switches be attached to a metal D-ring on the coxswain's lifejacket or survival vest and that the switches be inspected daily and tested weekly. However, individual Coast Guard units are being tasked with evaluating the proper location and operation of kill switches, which may be beyond the technical qualifications of some units. Because the placement and arrangement of kill switches may require special knowledge of ergonomics and human engineering, engineers and technicians with those skills should be part of any effort to redesign the kill switch system. The actions by the Coast Guard to improve kill switch use could be enhanced by including kill switch manufacturers and ergonomic/human engineering experts in the redesign process.

The Safety Board's investigation revealed safety deficiencies in the *Bayside Blaster*'s equipment and operations that led the Board to conclude that the Coast Guard's marine safety inspection program for small passenger vessels in the Miami area may be less than adequate. For the *Bayside Blaster* to receive a certificate of inspection to carry passengers, the Coast Guard must inspect and certify that the vessel meets the small passenger regulations at 46 CFR 175-185. The *Bayside Blaster* was deficient in at least three respects:

- Safety Board investigators found that lifejackets were not readily available to passengers in the aft part of the vessel, although the *Bayside Blaster* had recently been inspected and approved for operation by the Coast Guard. As the oversight authority for marine safety, Coast Guard inspectors should not permit such arrangements. They should use inspections as an opportunity to review the purpose of the regulations with vessel owners and to improve the safety of passengers by ensuring that lifejackets are readily accessible in an emergency.
- After the accident, the Coast Guard in Miami advised the Safety Board that the navigation lights of the *Bayside Blaster* were not configured in accordance with the Inland Navigation Rules. The measurements taken by the Coast Guard after the accident should have been taken during its 2001 inspection, and corrections should have been made to ensure regulatory compliance.
- The master and operations manager of the *Bayside Blaster* stated that the vessel had repeatedly, though infrequently, operated shorthanded. Their statements indicate that a continuing safety deficiency regarding small passenger vessel operations in Biscayne Bay remained undetected by the Coast Guard. While the owner of the vessel has a primary responsibility for safety oversight, the Coast Guard has an equally important responsibility to maintain oversight of the operations of all small passenger vessels under its inspection authority.

In light of the issues discussed above, the National Transportation Safety Board makes the following safety recommendations to the U.S. Coast Guard:

> Establish oversight procedures for use by the commanding officers or officers-in-charge of Coast Guard stations to improve the safety of Coast Guard routine small boat operations, including the institution of in-depth predeparture briefings, thorough predeparture checks of boats, monitoring of coxswain performance, and thorough postpatrol debriefings. (M-02-25)
>
> Evaluate on an annual basis your program for reducing nonstandard boat accidents and for ensuring compliance with Coast Guard policies and procedures related to those vessels; publish the results annually for use by Coast Guard stations. (M-02-26)

> Evaluate the adequacy of the design of present or future kill switch systems on Coast Guard small boats, giving full consideration to ergonomic/human engineering factors. (M-02-27)
>
> Evaluate the adequacy of the marine safety inspection program in the Miami area to ensure that small passenger vessels are in compliance with applicable regulations, including the requirements for lifejacket stowage, navigation lights, and manning. (M-02-28)

As a result of this investigation, the Safety Board also issued safety recommendations to Boatrides International, Inc. (owner of the *Bayside Blaster*), and the Passenger Vessel Association. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendations. In your response to the recommendations in this letter, please refer to M-02-25 through -28. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Sighed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: December 30, 2002

In reply refer to: M-02-29 and -30

Mr. Charles Sofge
President
Boatrides International, Inc.
555 NE 15th Street, No. 102
Miami, Florida 33132

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

The recommendations address the adequacy of management oversight by your company and the stowage of lifejackets on your company's vessel. The recommendations derive from the Safety Board's investigation of the collision between the U.S. Coast Guard patrol boat *CG242513* and the small passenger vessel *Bayside Blaster* in Biscayne Bay, Florida, on January 12, 2002, and is consistent with the evidence we found and the analysis we performed.[1] As a result of the investigation, the Safety Board has issued safety recommendations to the Coast Guard, the Passenger Vessel Association, and Boatrides International, Inc. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendations.

Based on its investigation, the Safety Board determined that the probable cause of the collision between the *CG242513* and the *Bayside Blaster* was the failure of the coxswain of the Coast Guard patrol boat to operate his vessel at a safe speed in a restricted-speed area frequented by small passenger vessels and in conditions of limited visibility due to darkness and background lighting. Contributing to the cause of the accident was the lack of adequate Coast Guard oversight of nonstandard boat operations.

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[1] For further information, read National Transportation Safety Board, *Collision Between the U.S. Coast Guard Patrol Boat* CG242513 *and the U.S. Small Passenger Vessel* Bayside Blaster*, Biscayne Bay, Florida, January 12, 2002*, Marine Accident Report NTSB/MAR-02/05 (Washington, DC: NTSB, 2002).

From interviews with an official of Boatrides International, Inc., and with the master and deckhand of the *Bayside Blaster*, Safety Board investigators determined that the sightseeing vessel departed on the accident voyage without one of the two deckhands required by its certificate of inspection (issued by the Coast Guard in August 2001). Despite the specific requirement of the company's procedures and policy manual to report deficiencies, the master did not notify management that he did not have the required crew before departing on the accident voyage. The master stated that he made the decision it was safe to sail with only one deckhand and that he had done so in the past, although infrequently. The company's operations manager stated that he was not informed the *Bayside Blaster* was short one deckhand before the vessel departed on the accident voyage. He also indicated that he was aware it was not the first time the *Bayside Blaster* had sailed shorthanded, but that it did not typically do so.

Company procedures required the master to report the number of passengers on board before leaving the dock. It would have been a simple matter to require him at the same time to report whether he had a full crew on board. Moreover, because the *Bayside Blaster* had departed without a full crew in the past, management should have been aware that it was possible for the vessel to be shorthanded and should have established procedures to arrange for backup crewmen so that such incidents did not occur in the future.

In assessing the impact on safety of the lack of the second deckhand on the *Bayside Blaster*, the Safety Board considered the opinions of the vessel master. The master stated that if the second deckhand had been present, he would have been selling drinks and film to the passengers and would not have been serving as a dedicated lookout. The lack of the required second deckhand did not affect the ability of the *Bayside Blaster* to maintain a proper lookout, but it meant that one less person was available to assist the passengers in the emergency. The second deckhand could have been helpful in handing out lifejackets to passengers, in helping passengers don and secure their lifejackets, and in helping the passengers disembark after the accident.

Had the accident been more serious, however, the need for the second deckhand could have been critical. If, for example, passengers had been seriously injured or thrown into the water and in danger of drowning, the second deckhand would have been needed for such duties as providing medical assistance or handling the boat while the master rendered medical assistance. If the boat had been in danger of sinking, the second deckhand would have been needed to help with damage control, to help distribute lifejackets, or to help the passengers safely abandon the vessel. The Safety Board concluded that operating the *Bayside Blaster* without the required number of crewmembers could have had a negative impact on the safety of the passengers, although it did not in this accident.

The Safety Board also concluded that the master of the *Bayside Blaster* was operating his vessel at a safe and prudent speed and that he and the deckhand were maintaining a proper lookout. The Safety Board further concluded that the master was precluded from taking action to avoid the collision by the high speed and sudden appearance of the Coast Guard patrol boat, and that in beaching the *Bayside Blaster* after the collision, the master acted appropriately, because he did not know the extent of the damage to his vessel.

In examining the *Bayside Blaster* after the accident, Safety Board investigators found that the adult-size lifejackets stowed in lockers at the vessel's bow were difficult to retrieve, and that no lifejackets were stowed in the aft accommodation area. The vessel's child-size lifejackets were stored in a compartment at the operator's station, but the opening mechanism was broken and had to be pried open. Both the single stowage location of adult lifejackets and the broken opening mechanism on the child lifejacket stowage compartment delayed the distribution of lifejackets to all passengers. Fortunately, the delay did not affect the outcome of the accident. However, under different circumstances, the delay in distributing lifejackets could have had serious consequences. The Safety Board concluded that if lifejackets had been stowed throughout the accommodation space on the *Bayside Blaster,* they would have been more readily accessible to the passengers.

Small passenger vessels such as the *Bayside Blaster* that carry 150 or fewer passengers or have overnight accommodations for 49 or fewer passengers are required by Title 46 *Code of Federal Regulations* (CFR) part 180.78 to have lifejackets "stored in convenient places distributed throughout accommodation spaces." (The same regulation is found at 46 CFR 117.78 for small passenger vessels that carry more than 150 passengers or more than 49 overnight passengers.) The CFR further requires that "each lifejacket kept in a storage container must be readily available."

Stowage of lifejackets on small passenger vessels was an issue in the Safety Board's recent investigation of the November 2000 fire on board the *Port Imperial Manhattan*.[2] After that accident, the owner of the *Port Imperial Manhattan*, New York Waterway, voluntarily elected to modify lifejacket stowage on its vessels. Lifejackets on New York Waterway vessels are now stowed under the passenger seats. The Safety Board is aware that the original stowage arrangements for lifejackets on the *Bayside Blaster* were approved by the Coast Guard. The same was true of New York Waterway vessels before the *Port Imperial Manhattan* fire. The Safety Board is convinced that, despite Coast Guard approval of the lifejacket arrangements on the *Bayside Blaster*, Boatrides International should consider voluntarily reconfiguring the way lifejackets are stowed on the vessel to make them readily available to passengers.

In light of the above issues, the National Transportation Safety Board makes the following safety recommendations to Boatrides International, Inc.:

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[2] For further information, see National Transportation Safety Board, *Fire On Board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

> Establish procedures to prohibit your small passenger vessel from leaving the pier with passengers on board unless the vessel has the crew required by the vessel's certificate of inspection. (M-02-29)
>
> Revise the stowage of lifejackets on board your vessel so they are located throughout the passenger areas for immediate use in case of emergency. (M-02-30)

In your response to the recommendations in this letter, please refer to M-02-29 and -30. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December 30, 2002

In reply refer to: M-02-31

Mr. John Groundwater
Executive Director
Passenger Vessel Association
801 North Quincy Street, Suite 200
Arlington, Virginia 22203

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the adequacy of lifejacket distribution on small passenger vessels. The recommendation derives from the Safety Board's investigation of the collision between the U.S. Coast Guard patrol boat *CG242513* and the small passenger vessel *Bayside Blaster* in Biscayne Bay, Florida, on January 12, 2002, and is consistent with the evidence we found and the analysis we performed.[1] As a result of the investigation, the Safety Board has issued safety recommendations to the Coast Guard, Boatrides International, Inc. (owner of the *Bayside Blaster*), and the Passenger Vessel Association. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

Based on its investigation, the Safety Board determined that the probable cause of the collision between the *CG242513* and the *Bayside Blaster* was the failure of the coxswain of the Coast Guard patrol boat to operate his vessel at a safe speed in a restricted-speed area frequented by small passenger vessels and in conditions of limited visibility due to darkness and background lighting. Contributing to the cause of the accident was the lack of adequate Coast Guard oversight of nonstandard boat operations.

In the course of its investigation, the Safety Board found that the adult-size lifejackets stowed in lockers at the *Bayside Blaster*'s bow were difficult to retrieve, and that no lifejackets were stowed in the aft accommodation area. The vessel's child-size

[1] For further information, read National Transportation Safety Board, *Collision Between the U.S. Coast Guard Patrol Boat* CG242513 *and the U.S. Small Passenger Vessel* Bayside Blaster*, Biscayne Bay, Florida, January 12, 2002*, Marine Accident Report NTSB/MAR-02/05 (Washington, DC: NTSB, 2002).

lifejackets were stored in a compartment at the operator's station, but the opening mechanism was broken and had to be pried open. Both the single stowage location of adult lifejackets and the broken opening mechanism on the child lifejacket stowage compartment delayed the distribution of lifejackets to all passengers. Fortunately, the delay did not affect the outcome of the accident. Under different circumstances, however, the delay in distributing lifejackets could have had serious consequences.

Small passenger vessels such as the *Bayside Blaster* that carry 150 or fewer passengers or have overnight accommodations for 49 or fewer passengers are required by Title 46 *Code of Federal Regulations* (CFR) part 180.78 to have lifejackets "stored in convenient places distributed throughout accommodation spaces." (The same regulation is found at 46 CFR 117.78 for small passenger vessels that carry more than 150 passengers or more than 49 overnight passengers.) The CFR further requires that "each lifejacket kept in a storage container must be readily available."

The Safety Board is concerned that the lifejacket problems identified on the *Bayside Blaster* may not be unique to that vessel and that the owners of other small passenger vessels need to be reminded of the safety standards. More than 350 vessel owners and operators of small passenger vessels, or about 65 percent of the owner-operators nationwide, belong to the Passenger Vessel Association. The Safety Board is aware that an objective of the association is to help its member companies improve the safety of their passenger vessel operations and that the association has published risk management and training manuals for that purpose. The risk management manual contains a section on signage for lifesaving equipment that covers marking lifejacket lockers but not the Federal requirement for storing lifejackets in convenient places and distributing them throughout accommodation spaces.

Stowage of lifejackets on small passenger vessels was an issue in the Safety Board's recent investigation of the November 2000 fire on board the *Port Imperial Manhattan*.[2] After that accident, the owner of the *Port Imperial Manhattan*, New York Waterway, voluntarily elected to modify lifejacket stowage on its vessels. Lifejackets on New York Waterway vessels are now stowed under the passenger seats. The Safety Board is aware that the Coast Guard approved the original stowage arrangements for lifejackets on the *Bayside Blaster*, and that the same was true of New York Waterway vessels before the *Port Imperial Manhattan* fire. Nevertheless, the Safety Board believes that the owners of small passenger vessels should consider voluntarily reconfiguring the way lifejackets are stowed to make them more readily available to passengers.

The National Transportation Safety Board, therefore, makes the following safety recommendation to the Passenger Vessel Association:

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[2] For further information, see National Transportation Safety Board, *Fire On Board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000*, Marine Accident Report NTSB/MAR-02/02 (Washington, DC: NTSB, 2002).

> Include in your *Risk Management Manual* the information that lifejackets on small passenger vessels should be evenly distributed throughout passenger areas for immediate use in an emergency, as prescribed by 46 CFR 117.78 or 180.78. (M-02-31)

In your response to the recommendation in this letter, please refer to M-02-31. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman